Large-scale Synthesis of Monodisperse Nanocrystals of Ferrites and Oxides and their Biomedical Applications

Taeghwan Hyeon,* Jongnam Park, Kwangjin An, Jaeyun Kim, and Hyon Bin Na

National Creative Research Initiative Center for Oxide Nanocrystalline Materials and School of Chemical and Biological Engineering, Seoul National University, Seoul 151-744, Korea, Fax: 82-2-888-1604, thyeon@snu.ac.kr

We developed a new generalized synthetic procedure to produce monodisperse ferrite nanocrystals without a size selection process [1]. Highly-crystalline and monodisperse nanocrystals were synthesized from the thermal decomposition of metal-surfactant complexes. We synthesized monodisperse spherical nanocrystals of metals (Fe, and Ni), and metal oxides (γ-Fe_2O_3, Fe_3O_4, $CoFe_2O_4$, $MnFe_2O_4$, NiO, and MnO) [2]. We report the ultra-large-scale synthesis of monodisperse ferrite nanocrystals by the thermolysis of metal-oleate complexes [3, Figure 1]. We synthesized as much as 40 grams of monodisperse magnetite nanocrystals using 1 L reactor. Furthermore, the current synthetic procedure is very general, and was successfully used to produce the nanocrystals of MnO, CoO, $MnFe_2O_4$, $CoFe_2O_4$, and cube-shaped iron. By controlling the nucleation and growth processes, we were able to synthesize monodisperse magnetite nanoparticles with particle sizes of 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16 nm [4, Figure 2]. We developed a new generalized synthetic route to produce uniform-sized nanorods of Fe_2P, FeP, Co_2P, Mn_2P, Ni_2P from the thermal decomposition of syringe-pump-delivered metal-surfactant complexes [5].

The synthesized organic dispersable nanocrystals were transformed to hydrophilic water-dispersable nanocrystals by treating with phospholipids and PEG-derived surfactants. The resulting water dispersable and monodisperse nanocrystals of ferrites and oxides were successfully employed as new MRI contrast agents.

References

1. *J. Am. Chem. Soc*. **2001**, 123, 12798.
2. *Chem. Comm*. (*Invited Feature Article),* **2003**, 927.
3. *Nature Mater.* **2004**, 3, 891.
4. *Angew. Chem. Int. Ed. (Frontipiece article)* **2005**, 44, 2872.
5. *Angew. Chem. Int. Ed.* **2004,** 43, 2282; *J. Am. Chem. Soc* **2005**, 127, 8433.

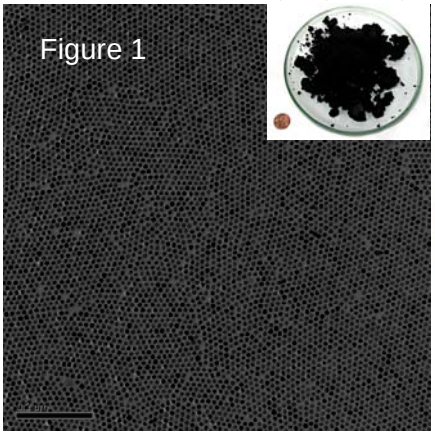

Figure 2